Delaware Tailwaters
Joint Trout Management Plan

A collaboration between the New York Department of Environmental Conservation and the Pennsylvania Fish and Boat Commission

January 22, 2025

[This page is intentionally left blank]

DELAWARE TAILWATERS JOINT TROUT MANAGEMENT PLAN

Authors:

New York State Department of Environmental Conservation

Chris VanMaaren
Tim Pokorny
Fred Henson
Gregory Kozlowski
Steve Hurst

Pennsylvania Fish and Boat Commission

Daryl Pierce
Nathan Walters
Cooper Barshinger
David Nihart
Kristopher Kuhn

Table of Contents

I. Introduction

The Delaware tailwaters support a nationally renowned sport fishery for wild trout. The New York City (City) Delaware River basin reservoirs, inclusive of the Cannonsville Reservoir located on the West Branch Delaware River (West Branch) and the Pepacton Reservoir located on the East Branch Delaware River (East Branch), influence 75 miles of river, including the West Branch, the East Branch, and the mainstem Delaware River downstream to Callicoon, NY at river mile (RM) 303 (Figure 1). Historical investigations characterized both biological (Sheppard 1980, 1983; Sanford 1989; McBride 2002; McBride et al. 2008) and social (McBride 2003) aspects of the Delaware tailwaters cumulating in a management plan (Sanford 1992) specific to the State of New York reaches of the tailwaters. Significant changes, notably improvements to seasonal flow regimes, have occurred in the Delaware tailwaters over the last two decades. In 2017, stakeholders voiced concerns that increased fishing pressure and harvest were causing negative impacts to the wild trout populations. However, the information available to resource managers was too outdated to evaluate the concerns. Given the value of this resource, the Pennsylvania Fish and Boat Commission (PFBC) and the New York State Department of Environmental Conservation (NYSDEC), collaboratively designed and implemented a three-year study, Joint Fisheries Investigation Plan (JFIP), in 2018 to collect biological and social data to assess the status of the fishery and create a new baseline of information. The data collected was used to develop this joint Fisheries Management Plan for the Delaware tailwaters (Plan) to guide the goals and objectives for managing the wild trout populations in the Delaware tailwaters.

This Plan applies the stewardship principles embodied in the mission statements of both agencies to manage the shared trout resource in a structured fashion[1,2].

II. Historic State of the Fishery

Under the historic fisheries management plan (Sanford 1992), the cold-water fishery was supported by a mix of wild brown trout, wild rainbow trout, and stocked brown trout. Management actions were designed to achieve catch rate-oriented objectives (Engstrom-Heg 1990). Specifically, the wild trout populations were supplemented with hatchery trout to target average catch rates of 1 trout/hour in the West Branch and 0.5 trout/hour in the East Branch and the Delaware River. However, these catch rate objectives were not achieved (McBride 2003).

Over time, the importance of wild trout to the trout fishery and to angler satisfaction regardless of catch rate increased. Enhanced conservation releases under a series of flow agreements

[1] To conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being.

[2] To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.

facilitated the growth and recruitment necessary to sustain a high-quality wild trout fishery, leading to the termination of stocking on the West Branch in 1995. Harvest rates decreased over time even as the reputation of the fishery attracted more anglers with fly fishing becoming the predominant angling technique. Meanwhile, redd surveys revealed brown trout spawning in the East and West branches and a radiotelemetry study demonstrated that trout tagged in the Delaware River were also using habitats in East and West branches and their cold-water tributaries (McBride 2002). In conclusion, the wild brown trout and rainbow trout populations have become sufficient to support the fishery.

III. Current State of the Fishery

The status of the current Delaware tailwater trout populations and associated sport fishery were characterized by the JFIP[3]. Findings were suggestive of stable, quality-sized wild brown trout and wild rainbow trout populations. This was evident in the modest annual variation in relative abundance of young-of-year (YOY) and yearling to older trout. The consistent prevalence of trout in the 12 to 18-inch size range, comprising approximately 50% of the total electrofishing catch, was noteworthy evidence of stable growth and recruitment of yearlings to the older year classes preferred by anglers. Redd count and YOY abundance data suggested that tributaries and the mainstem provide important spawning and nursery habitat with tributaries being particularly important for rainbow trout. Within the West Branch, most (97%) tagged trout remained at the point of capture; however, poor performance of detection arrays precluded quantification of tributary habitat use by mainstem West Branch populations. Throughout the investigation, reservoir releases successfully achieved habitat protection objectives for the West Branch outlined in the Flexible Flow Management Program (FFMP) [4], suggesting water temperature was not a limiting factor for the trout populations following implementation of the FFMP.

The Delaware tailwaters can be described as a destination fishery that receives high angler use, with a vast majority (97%) of anglers voluntarily releasing their catch. Angler satisfaction remained high, despite low catch rates, which likely was driven by their expectation of catching a large trout. Fishing pressure estimates validated the belief that angler use has increased substantially since the 1990s. This increase was largely attributable to anglers whose fishing trips encompassed at least two reaches of the Delaware tailwaters as defined in the JFIP creel survey methods and were termed “movers.” Estimated total angler catch was considerable, yet about two thirds of interviewed anglers caught no brown trout during their fishing trips while 85% of anglers caught no rainbow trout. Frequent healed hook scarring observed during electrofishing surveys was suggestive of “recycling” of trout by anglers. Unfortunately, it was

[3] Summary of findings of the Joint Fisheries Investigation for the Delaware tailwaters. 2023. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167.

[4] The Flexible Flow Management Program is a renewable agreement negotiated between the City of New York, State of New York, State of New Jersey, State of Delaware, and State of Pennsylvania under the terms of a 1954 Supreme Court Decree. Negotiations attempt to balance the interests of a diverse set of Delaware basin stakeholders.

not possible to quantify the proportion of previously caught trout in the total reported catch. Interestingly, reported size distribution of fish caught by anglers mimicked similar size distribution observed from electrofishing catch rates. Thus, while anglers indicated targeting large trout, they instead caught trout sizes that were in proportion to what was available from the population. Overall, angler effort and catch reflect a fishery in which trout are challenging to catch, not sparse populations. Electrofishing results provide reassurance trout populations are not in decline.

IV. Principal findings of the Joint Fisheries Investigation Plan

- The Delaware tailwaters are not uniformly hospitable to all life stages of trout. The trout populations depend on movement and dispersal among habitats to achieve the full potential of the fishery.
- Year class strength, recruitment to adult, and mortality appear sustainable. In combination, the tributaries and mainstem waters provide for more resilient trout populations than if recruitment depended entirely on the reproductive capacity of one or the other.
- Trout may be caught year-round throughout the system; however, the West Branch offers the most consistent year-round trout angling opportunities due to flow and temperature characteristics which heavily influence trout abundance.
- Low trout harvest within the Delaware tailwaters is more driven by the voluntary catch-and-release fishing than by regulation. The nominal harvest by few anglers is insufficient to influence either abundance or size distribution of the population.
- While angler preference is to target the larger trout, the sizes of trout caught by anglers reflect the size structure of the trout population.
- Angler satisfaction is greatly influenced by factors beyond conventional catch statistics (e.g., catch rate). Rather angler satisfaction appears strongly tied to the perceived opportunity for catching exceptionally large wild trout.

V. Goal

Monitor, sustain, and promote a premier sport fishery for both wild brown trout and wild rainbow trout within the Delaware tailwaters to detect change and respond in an adaptive fashion.

A scientific quantification of the trout population and fishery is important for effective management and advocacy in the high value, multi-stakeholder context of the Delaware tailwaters. The primary management actions in support of this goal are listed below. However, the agencies may independently pursue additional actions and analyses complementary to the objectives of this plan.

- Monitoring (fishery dependent and fishery independent)
    - The Delaware tailwaters is a significant fishery that requires routine monitoring of the trout populations and anglers to continue to inform management.
- Instream and riparian habitat enhancement.
    - To optimize the Delaware tailwaters trout populations, reach-scale or site-specific habitat enhancement projects could improve habitats for various lifestages.
- Outreach
    - Outreach and stakeholder engagement is critical for successful implementation of fishery management plans. As such, the results of Delaware tailwaters assessments will be routinely shared with stakeholders in a collaborative manner.

VI. Scope

Based on the documented movements of trout and interaction of flows authorized under the FFMP, this Plan applies to the wild trout fishery of the Delaware tailwaters (Figure 1) defined as:

- The mainstem of the Delaware River from Callicoon upstream to the confluence of the East and West branches at Hancock, NY;
- The West Branch from Hancock to the weir in Stilesville; and
- The East Branch from Hancock to Downsville.

Focus will be on the West Branch due to the robust data sets collected during the JFIP and the high level of fishing pressure. Historical findings (McBride 2002) clearly indicate tributaries are important as both spawning and nursery habitat and/or thermal refugia for wild trout population in the Delaware tailwaters; therefore, investigations will include select tributaries to the West Branch.

VII. Controllable Variables

Recreational fisheries are usually managed using three controllable variables (habitat, regulations, stocking).

Habitat

Trout habitat suitability is largely driven by the flows defined by the negotiated FFMP. Trout habitat needs are addressed in the FFMP, but the outcome of negotiations is beyond the control of the fisheries managers. The system does have opportunities for instream habitat enhancement.

Regulations

Harvest regulations have little or no impact on the trout fishery on the Delaware tailwaters due to the prevalence of catch and release behavior of anglers.

Stocking

Stocking is unnecessary given the productivity of the tailwaters system.

Some habitat enhancement can take place and outreach can be used to influence angler behavior, but given this environment, managers have few levers to pull to effect change.

VIII. Monitoring

Status of the Trout Population

Time-series data derived from the fishery-independent monitoring (i.e., electrofishing) based on the JFIP study will be the primary data source used to inform management decisions. Annual arithmetic averages with associated 95% confidence intervals of survey catch rates (fish/h), combined by month, site location, and tributary (excluding mainstem sites) will be used to describe overall population status (i.e., relative abundance) within the West Branch basin of the Delaware tailwaters.

Performance zones will provide guidance regarding population sustainability and offer a mechanism to promote the fishery. Performance zones were defined based on monitoring data gathered from 2017 to 2022 and will be updated accordingly as additional monitoring is accomplished. These time-series trends are used as a surrogate for true population change. Thus, interpretation of time-series performance zones is considered more of guidance than true condition.

A fishery is considered sustainable when the catchable population does not decline over time and reproduction consistently occurs at levels to support this trend. Thus, identifying and appropriately interpreting population trends that influence sustainability is needed. As such, separate indices were derived based on species-specific size ranges:

- Juvenile production of brown trout and rainbow trout (≤ 5 inches) in the West Branch mainstem (Figure 2) and select tributaries (Figure 3) of the West Branch;
- Brown trout and rainbow trout spawning stock relative abundance (≥ 12 inches; Figure 4);
- Large brown and rainbow trout relative abundance (≥ 16 inches and ≧ 14 inches, respectively) (Figure 5);
- Trophy brown and rainbow trout relative abundance (≧ 20 inches and ≧ 16 inches, respectively) (Figure 6); and
- The long-term average of the time-series from 2017 to 2022 for each index was also defined to aid interpretation; but does not infer performance zone status or management action.

A traffic light approach employing confidence intervals around time-series abundance was used to define performance zones. Annual arithmetic averages of the trout relative abundance and

size distribution was used, and trend interpretation employs assessment of the annual range of confidence intervals among years. Considerable overlap of confidence intervals implies no significant difference among annual estimates. The scale of variation was separated into three conditions listed below.

- Green represents a sustainable trout population and is defined as the lowest annual 80% confidence value in the time-series or greater values. The population is considered Green when the current annual average is greater than the minimum. The extent of annual average confidence limits less than the Green zone does not infer a degraded status.

- Yellow also represents a sustainable trout population but is defined as the lowest 80% confidence value to the lowest 99% confidence value in the time-series. The population is considered Yellow when the current annual average falls within the defined boundaries. A Yellow classification warrants increased scrutiny with consideration of management action. The extent of annual average confidence limits into adjacent performance zones does not infer either improved or degraded status.

- Red represents an unsustainable population that may warrant management action. The current annual average is less than the time-series lowest 99% confidence value. The extent of annual average confidence limits into other performance zones does not infer an improved status.

Failure (exceedance) is defined as three non-consecutive annual average values within the Red performance zone out of the most recent five years. However, severity of exceedance may warrant management actions as deemed necessary. Agencies will annually review the indices of the trout population. No management actions are associated with the trophy-sized brown trout or rainbow trout (all sizes) indices, given the low densities of these fish in the populations resulting frequent zero catch rate values. Rather these indices simply serve as a reference to population status.

Indices of growth and condition (PIT Tagging)

To address the objective of monitoring and understanding variability of trout size classes, sampling will include the use of passive integrated transponder (PIT) tags. Recapturing tagged fish is the easiest, most cost efficient, and most accurate means of determining growth rates. Growth rates allow managers to determine time to size and account for variability of size classes as abundance can be tracked over time. As the relative abundance metrics are assessed from year to year, knowledge of time to size will allow managers to identify when impacts to various cohorts are occurring.

Tagging adds the benefit of tracking movement throughout the sampled reaches. Movement can also affect abundance metrics from year to year. Movement to and from the tributaries has been hard to identify. Adding yearling tagging in the tributaries will allow managers to better

understand why more older trout are not found in the tributaries. Similarly, movement within waters varies from year to year and creates variability that is important to track.

Tagging would continue during both the West Branch and the tributary electrofishing events with yearling tagging added to the tributary protocol. A tagging program will be established for the East Branch. All yearling and greater size trout will be scanned for PIT tags during all sampling events. JFIP testing showed 95% tag retention rates. Sampling from 2018-2023 yielded 653 recaptures.

Fishery Dependent Indices

Creel surveys quantify key fishery characteristics such as angler behavior, expectations, and satisfaction relevant to management of the fishery. The JFIP 2018 and 2019 creel survey results demonstrated high angler satisfaction and showed that the Delaware tailwaters fishery is an increasingly popular destination fishery, even though catch and harvest rates were low. Fishery-dependent parameters (e.g., catch composition and catch rate) are influenced by angler ability[5]. The size of fish caught by anglers was similar to population size structure determined by fishery-independent monitoring, even though anglers indicated targeting larger sized trout[6]. Angler trip satisfaction can provide insight regarding trout population conditions. For example, most anglers reported a satisfactory trip[7,8,9] during both the 2018 and 2019 creel surveys, suggesting the trout abundance and population size structure met angler expectations. Furthermore, those surveys highlighted additional aspects of angler behavior that warrant more focused attention.

Under this Plan, updated angler data will be collected on a recurring basis to characterize participation, harvest, and behavior. Although creel surveys yield excellent insights to the fishery, they come at a high cost, both in terms of personnel and monetary resources. A two-fold approach for characterizing the fishery will be pursued:

1. Initiate a self-serve angler diary program; and,
2. Replicate the JFIP creel methodology.

Both will generate basic descriptive characteristics of the fishery (e.g., angler effort, catch, size structure, angler opinion, angler demographics).

---

[5] Population assessment of Brown Trout and Rainbow Trout within the Delaware tailwaters, 2017 – 2022: Joint Fisheries Investigation Plan Final Report. 2023. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167. In review.

[6] Summary of findings of the Joint Fisheries Investigation for the Delaware tailwaters. 2023. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167. Pending release.

[7] 2018 Progress Report: Creel Survey. 2019. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167. Weblink: 2018 Progress Report: Creel Survey (ny.gov).

[8] 2019 Progress Report: Creel Survey. 2020. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167. In review.

[9] 2018/19 Final Report: Creel Survey. 2022. NYSDEC Region 4 65561 State Highway 10, Suite 1, Stamford NY 12167. In review.

Self-serve angler diary programs have a long-standing tradition in the Delaware tailwaters. Those historical programs were reliant on a paper format that did not allow for efficient transfer of information. Typically, returned diaries mostly came from participating outfitter guides (N < 30 individuals), who were mandated to submit catch records to the National Park Service as part of licensing to operate within the Upper Delaware Scenic Recreational River. Survey findings were biased and only captured data from a small subset of fishery participants, specifically within the Delaware River mainstem.

The use of QR codes with cell phones could potentially refresh interest in a self-serve diary to a broader audience. As such, signs posted throughout the Delaware tailwaters will be used to solicit participation (Figure 7). The automated data collection and processing facilitated through this approach will be more efficient and reduce staff time.

Current knowledge of the fishery will be maintained by replicating the JFIP creel survey methodology. The survey will be conducted every five years to update fishery-dependent data for the Delaware tailwaters. The data will provide insight to angler pressure, satisfaction, and size structure of captured and/or harvested trout. Given that the JFIP creel survey was conducted during two consecutive seasons in 2018 and 2019), the every five year frequency does not allow for meaningful time-series metrics. While fishing mortality can be estimated from the 2018 and 2019 survey findings, detection of trends (e.g., increasing harvest) is limited. However, these characteristics can provide insight regarding the fishery-independent performance zones. For example, angler satisfaction will broaden managers understanding of trout abundance relative to angler opinions, and deviations potentially suggest changing angler sentiment.

IX. Habitat

Diverse, high-quality habitat is needed to support robust, sustainable fisheries. The current trout populations attest to the high-quality habitat of the Delaware tailwaters with resilience promoted by extensive spawning habitat in the tributaries and main channels. As such, it is uncertain that habitat enhancement work will produce measurable changes in trout population characteristics. Nonetheless, opportunities and partners will be sought to identify potential improvement opportunities and address specific impairments to maintain the overall quality of the trout habitat and the fishery. Habitat-focused management strategies are listed below.

- Collect baseline habitat data to quantify type and extent of existing habitat.
- Increase large fish holding habitat (microhabitat) by large wood additions and boulder placement.
- Increase stream habitat diversity.
- Increase the number of deep pools in the upper East Branch.
- Find thermal refuges on the East Branch for potential habitat enhancement and protection.

- Determine if fluvial fans are an impediment for fish to access thermal refuge or spawning habitat in tributaries.
- Look for opportunities to increase instream and riparian cover in tributaries and mainstem branches.

Based on the outcome of these explorations, the NYSDEC, the PFBC, and/or their partners will undertake projects to improve wild trout habitat in the Delaware tailwaters.

X. Reporting and Outreach

The world class reputation of the Delaware tailwaters and its proximity to population centers make the wild trout sport fishery the object of intense angling pressure and interest from diverse stakeholders. In this management environment, the sharing of information between anglers and fishery managers is vital. Under this Plan, the following outreach actions will be taken to achieve a more efficient and effective exchange of information.

- Publish an annual report card on the status of fishery.
- Make creel survey information available on a regular basis in the NYSDEC Fishing Line and through PFBC outlets.
- Promote angler survey participation (QR codes).
- Host periodic stakeholder meetings to disseminate information and solicit angler opinions.
- Install kiosks at access sites where feasible.

XI. Literature Cited

Engstrom-Heg, R. 1990. Guidelines for stocking trout streams in New York State. NYS Department of Environmental Conservation, Bureau of Fisheries, Albany, NY: 107 pp.

McBride, N. D. 2002. Radiotelemetry study of trout movements in the Delaware Tailwaters and the Beaver Kill: 1995-1997. New York State Department of Environmental Conservation, Region 4 Fisheries Office, Stamford, New York: 177pp.

McBride, N. 2003. NY FA-5-R Study VIII: New York State freshwater angler creel census project. Job 201:

Delaware Tailwaters Creel Census. New York State Department of Environmental Conservation, Region 4 Fisheries Office, Stamford, New York: 189pp.

McBride, N., R. Angyal, D. Zielinski, R. Klosowski, R. Bode, and W. Elliot. 2008. Final Report: Delaware River tailwaters monitoring, May 1, 2004 – September 30, 2007. New York Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Albany, NY, 12233 files.

Sheppard, J. D. 1980. New York reservoir releases monitoring and evaluation program: Performance report to the period 1 July 1978 – 31 December 1979. Technical report 80-1. New York State Department of Environmental Conservation. Albany, NY.

Sheppard, J. D. 1983. New York reservoir releases monitoring and evaluation program on the Delaware River summary report: Technical report 83-5. New York State Department of Environmental Conservation. Albany, NY.

Sanford, D. K. 1989. A fish survey of the lower East and West Branches of the Delaware River during 1987. New York Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Bureau of Fisheries – Region 4. 53 p.

Sanford, K. 1992. A fishery management plan for the Upper Delaware tailwaters. NYS DEC Albany, New York 89pp.

XII. Figures

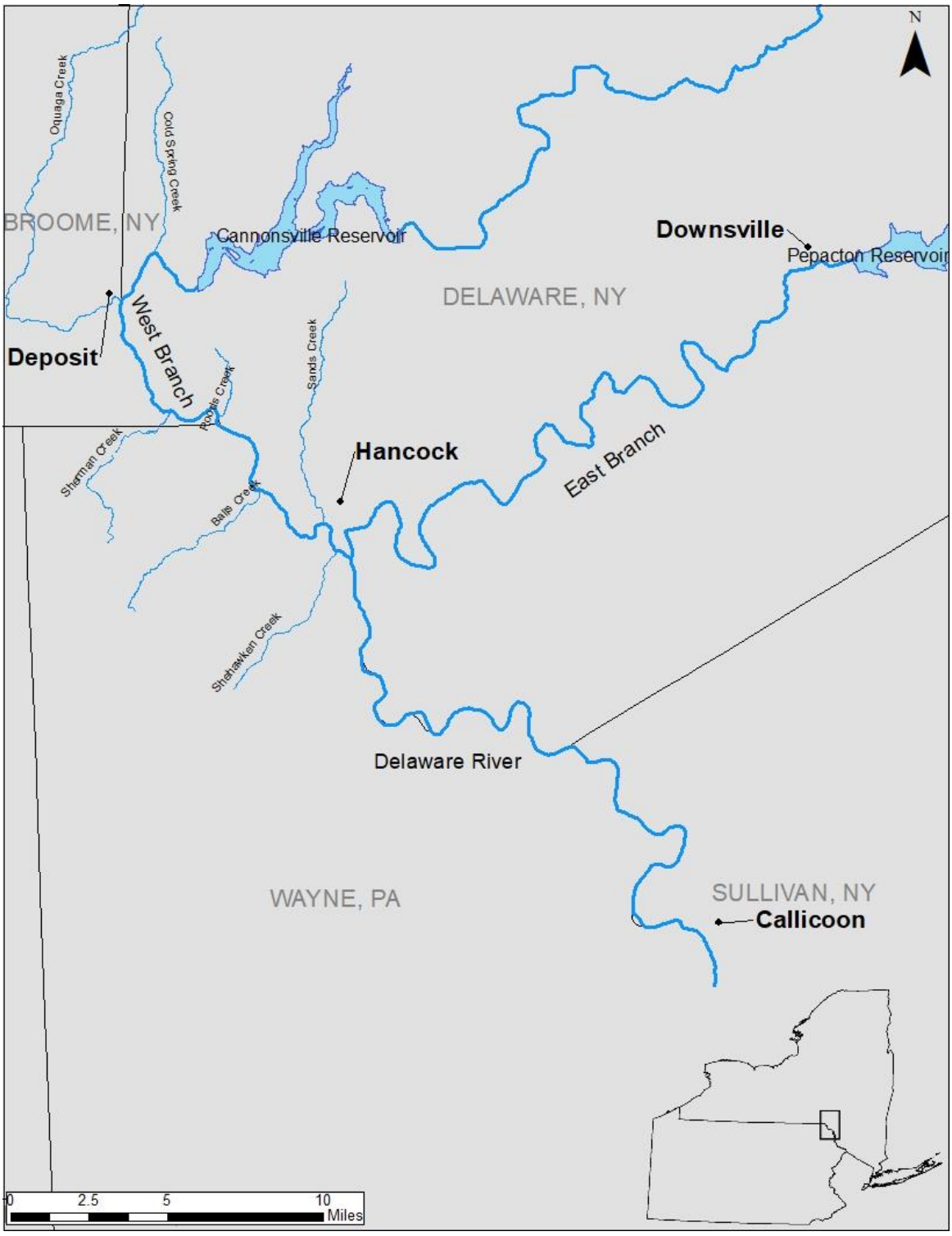
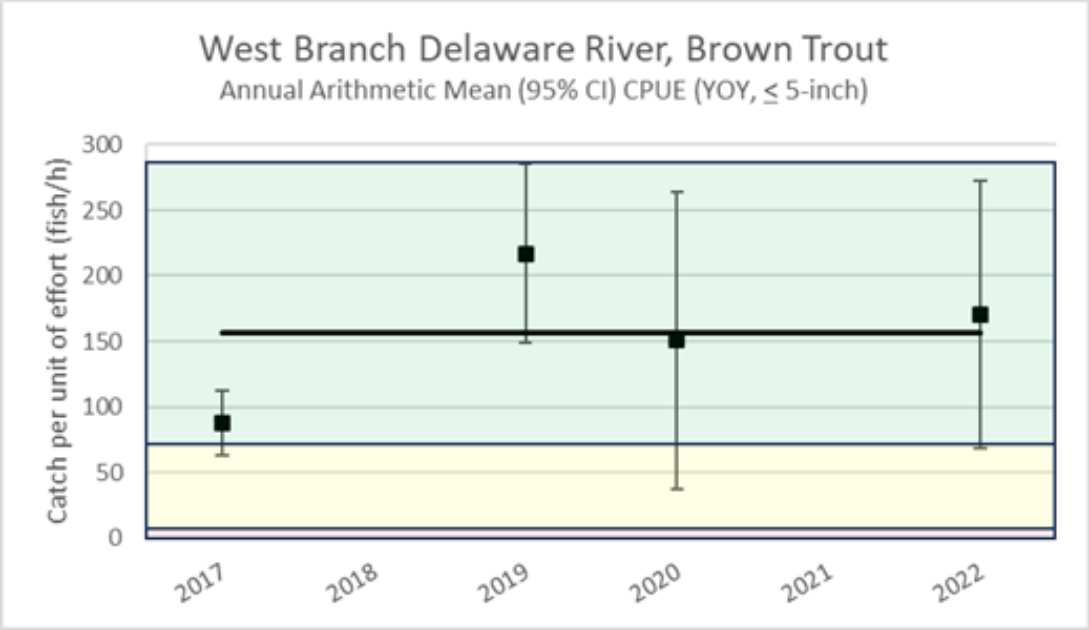


Figure 1. Delaware tailwaters.



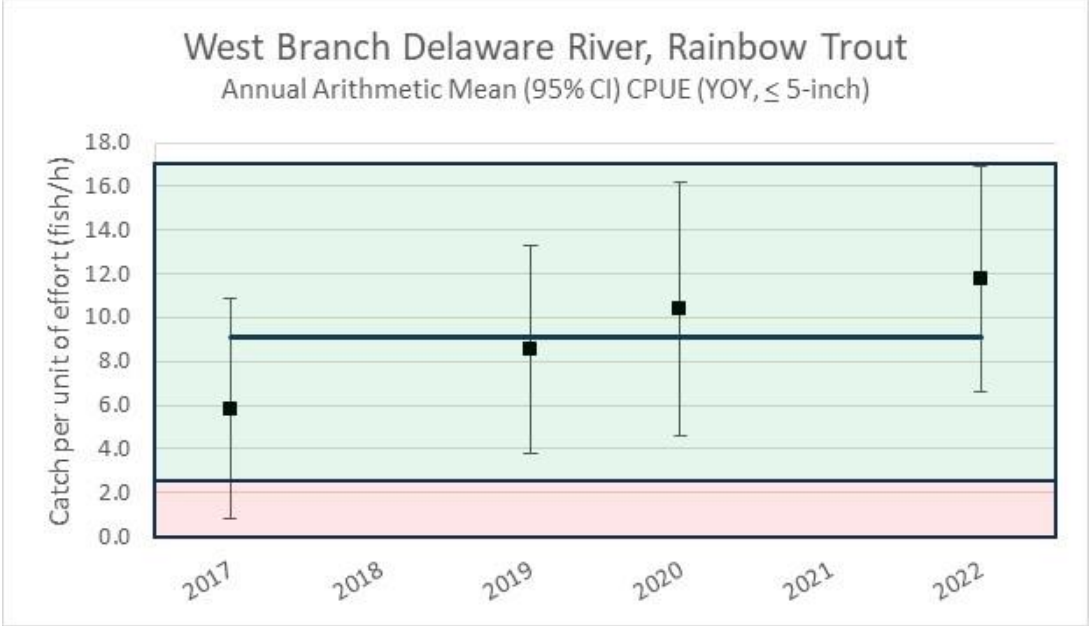
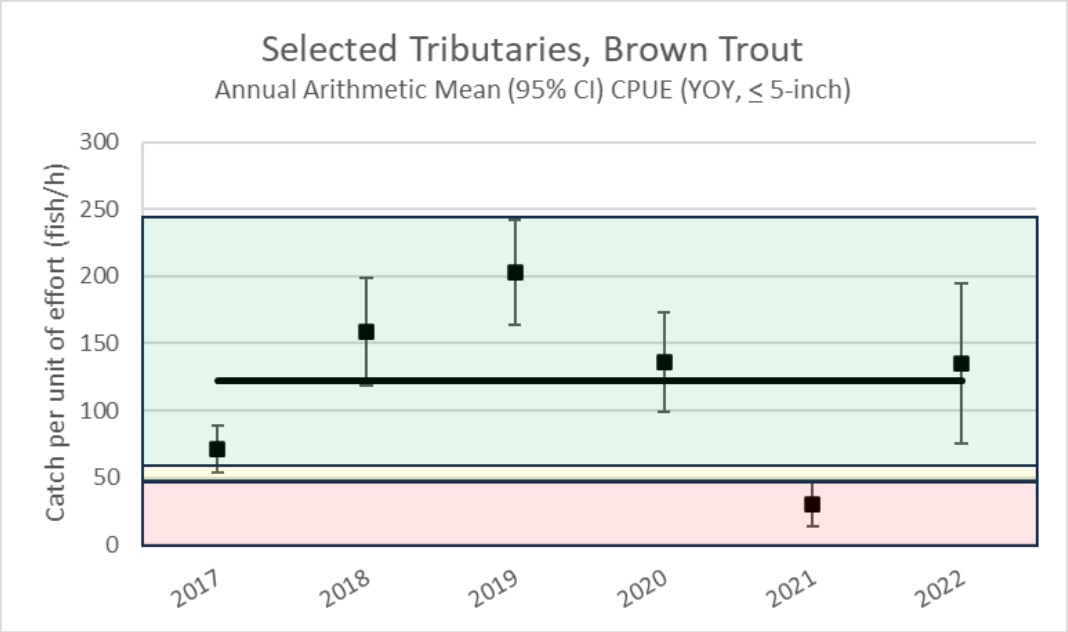


Figure 2. Relative abundance of young-of-year (YOY) brown and rainbow trout (≤ 5 inches) shown as annual averages with 95% confidence intervals of combined fixed sites catch rates (fish/hour) in the West Branch mainstem from daytime backpack electrofishing surveys conducted from July to October, 2017 to 2022. The performance zones represent sustainable populations (Green), declining sustainable populations (Yellow), and unsustainable populations (Red). The Yellow zone for rainbow trout was excluded due to near identical limits to the Red zone. No sampling occurred in 2018 and 2021 due to adverse river conditions. Both trout species are in the Green zone and considered sustainable.



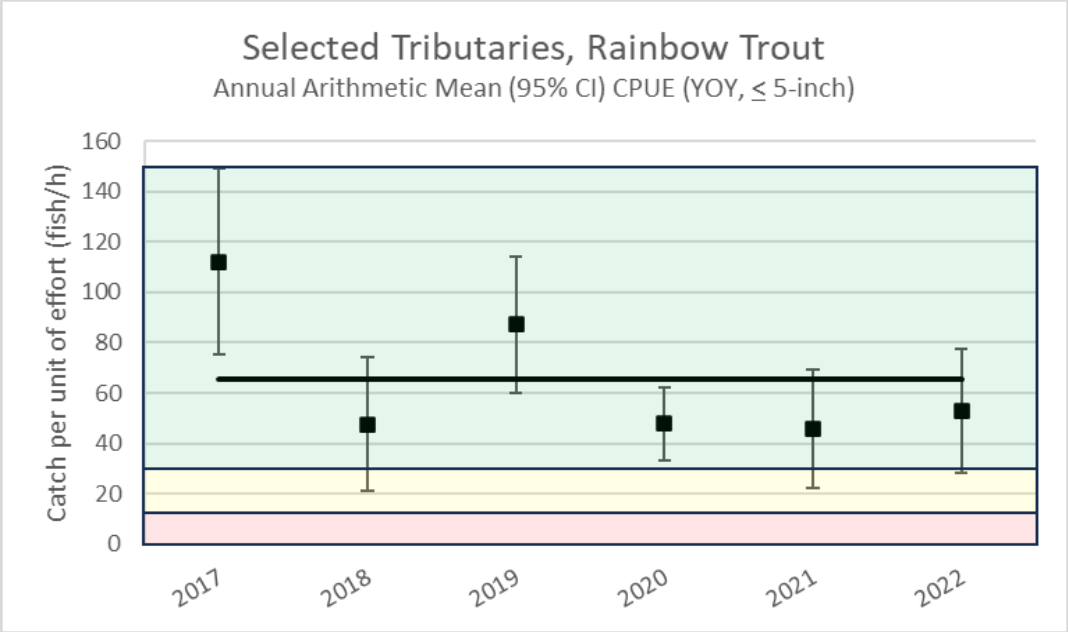
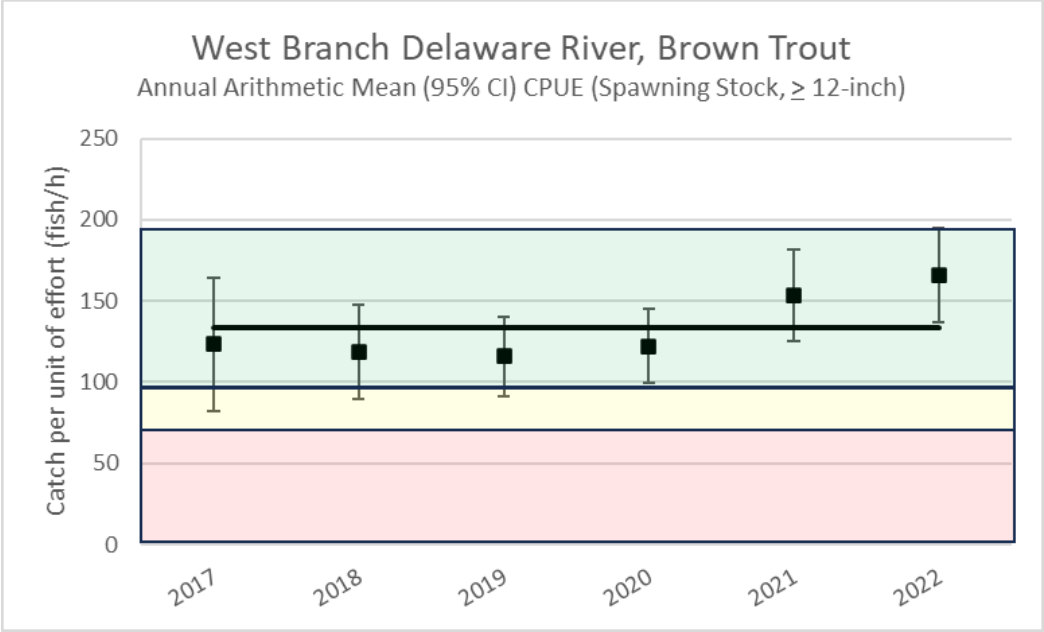


Figure 3. Relative abundance of young-of-year (YOY) brown and rainbow trout (≤ 5 inches) shown as annual averages with 95% confidence intervals of combined fixed sites catch rates (fish/hour) in the West Branch mainstem from daytime backpack electrofishing surveys conducted from July to October, 2017 to 2022. The performance zones represent sustainable populations (Green), declining sustainable populations (Yellow), and unsustainable populations (Red). Both trout species are in the Green zone and considered sustainable. While the 2021 brown trout annual average occurred in the Red zone, it was only a singular occurrence.



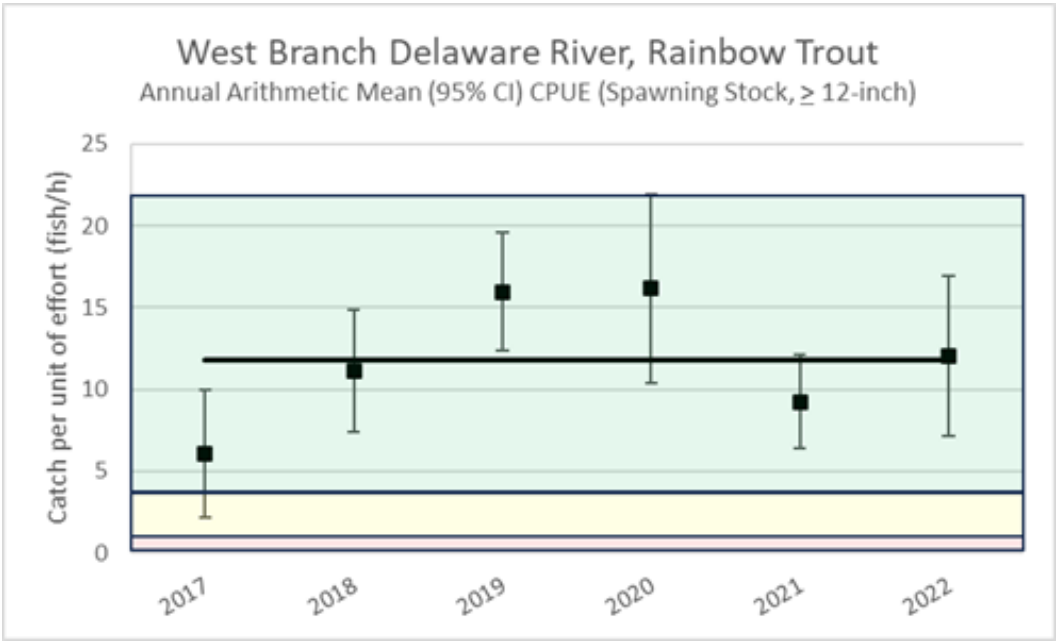
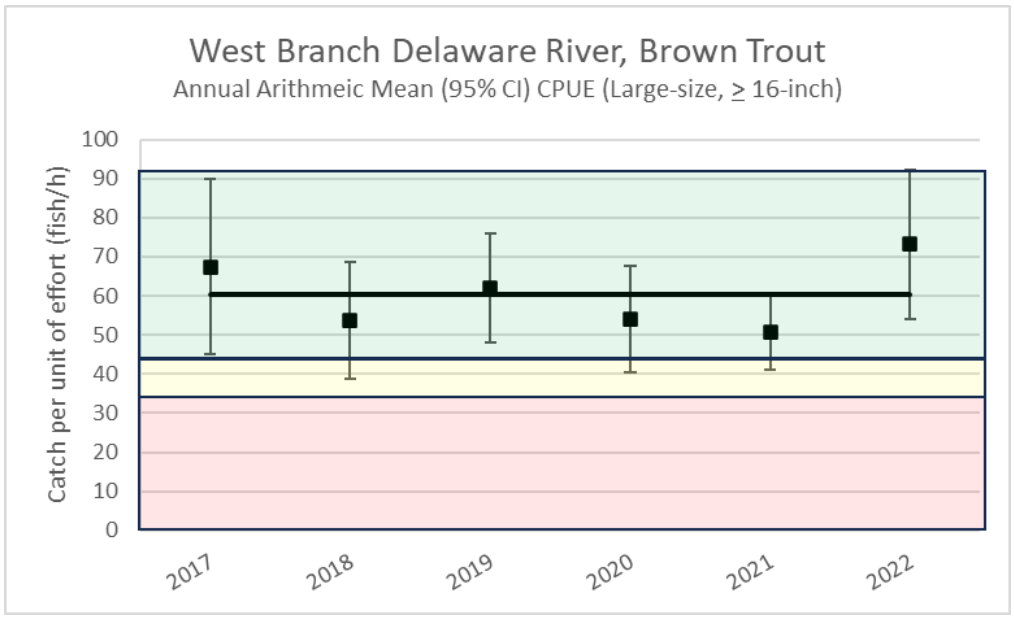


Figure 4. Relative abundance of spawning stock size brown and rainbow trout (≥ 12 inches) shown as annual averages with 95% confidence intervals of combined fixed sites catch rates (fish/hour) in the West Branch mainstem from nighttime boat electrofishing surveys conducted from April to October, 2017 to 2022. The performance zones represent sustainable populations (Green), declining sustainable populations (Yellow), and unsustainable populations (Red). Both species are in the Green zone and considered sustainable.



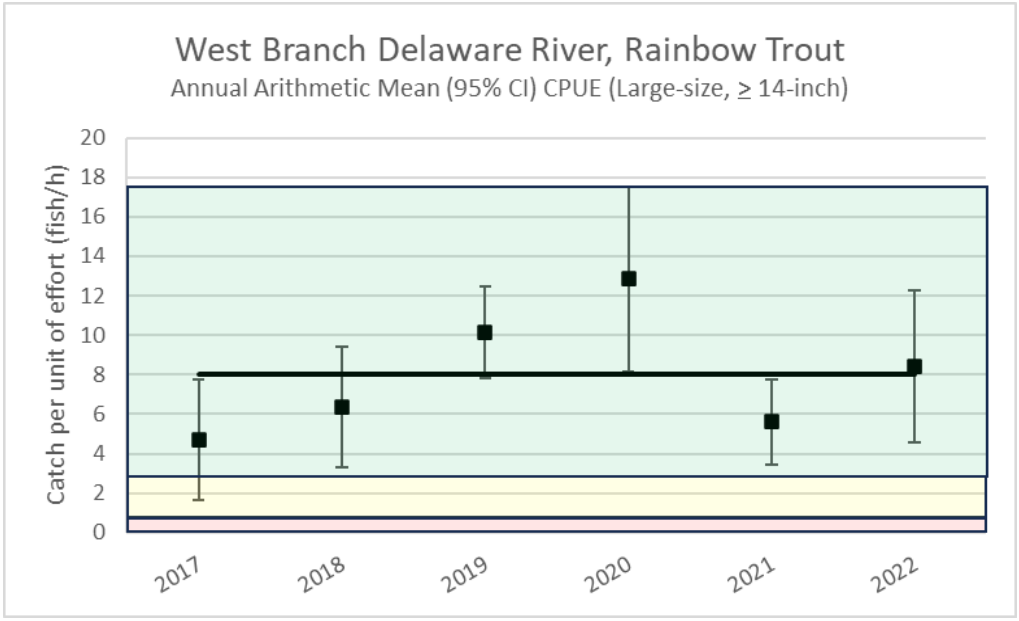
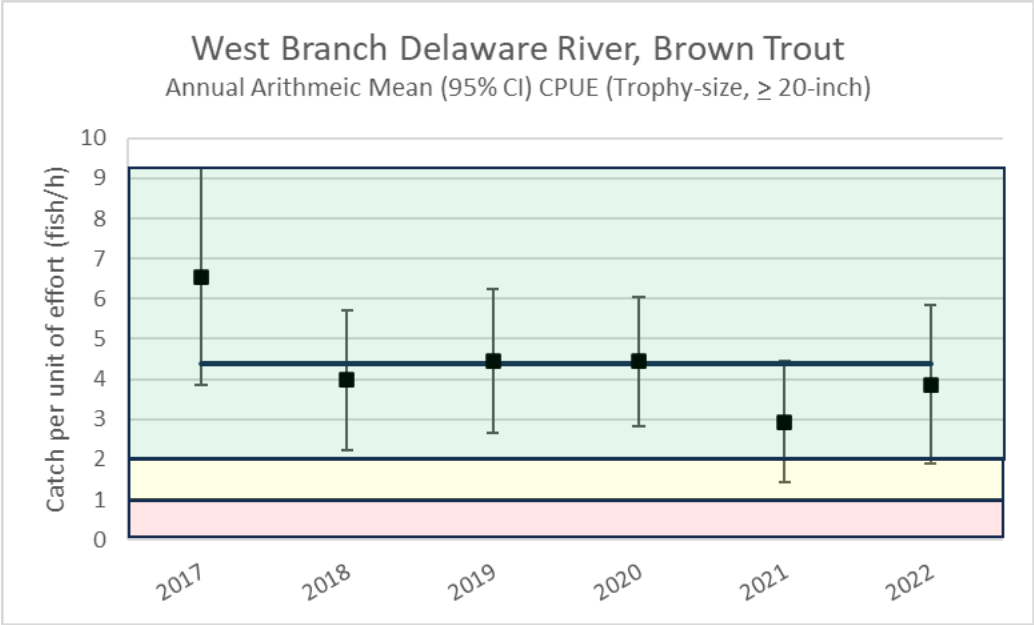


Figure 5. Relative abundance of large brown and rainbow trout (≥ 16 inches and ≥ 14 inches, respectively) shown as annual averages with 95% confidence intervals of combined fixed sites catch rates (fish/hour) in the West Branch mainstem from nighttime boat electrofishing surveys conducted from April to October, 2017 to 2022. The performance zones represent sustainable populations (Green), declining sustainable populations (Yellow), and unsustainable populations (Red). Both species are in the Green zone and considered sustainable.



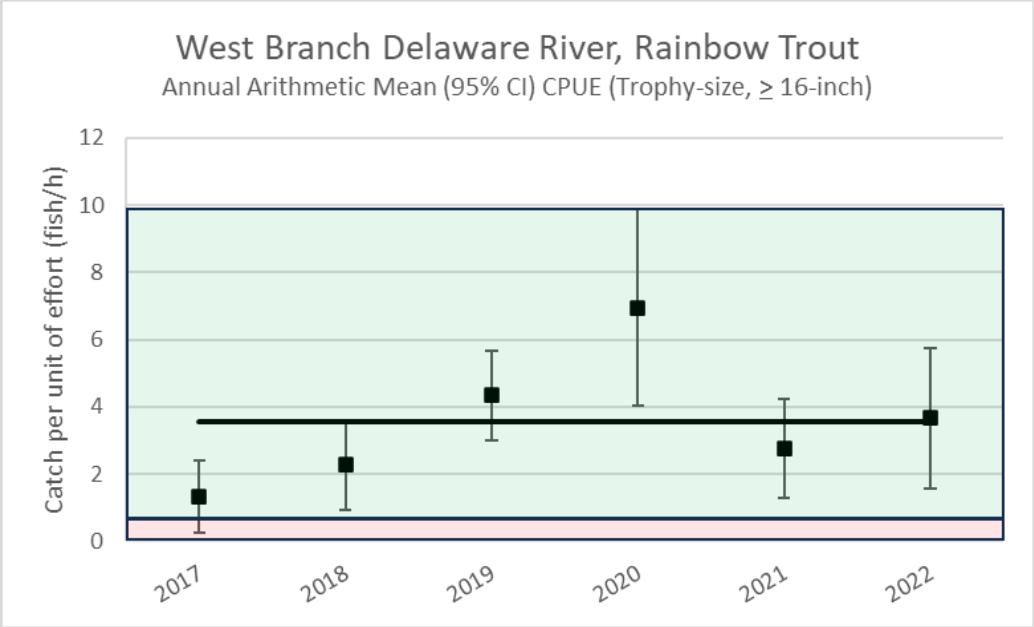


Figure 6. Relative abundance of trophy brown and rainbow trout (≥ 20 inches and ≥ 16 inches, respectively) shown as annual averages with 95% confidence intervals of combined fixed sites catch rates (fish/hour) in the West Branch mainstem from nighttime boat electrofishing surveys conducted from April to October, 2017 to 2022. The performance zones represent sustainable populations (Green), declining sustainable populations (Yellow), and unsustainable populations (Red). The yellow condition for rainbow trout was excluded due to near identical limits to the red condition. Both species are in the Green zone and considered sustainable.

Figure 7. Map of QR code locations along the Delaware tailwaters.